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RETRIEVAL OF CLOUD WATER DISTRIBUTION FROM AN AIR-BORNE SCANNING MICROWAVE RADIOMETER: WAKASA BAY FIELD EXPERIMENT RESULTS

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ABSTRACT

Cloud tomography offers a new promise to measure 3D cloud water distribution from passive microwave radiometers that are usually used to retrieve only path-integrated water content. The feasibility of this method has been demonstrated by several observation system simulation studies, while field trials are needed to further verify its usefulness. During the 2003 Wakasa Bay AMSR-E validation campaign, the Polarimetric Scanning Radiometer (PSR) and Microwave Imaging Radiometer (MIR) aboard the NASA P-3 platform scanned through a system of shallow convective clouds and thus provided suitable data for testing the cloud tomography method. The cloud field retrieved using a constrained inversion algorithm based on the combined PSR along-track and MIR nadir data appears to be physically plausible and is consistent with the cloud spatial structure obtained by a cloud radar. Unfortunately, a quantitative validation of the retrieved cloud water distribution is not feasible since the cloud radar could not provide a useful estimation of this quantity for precipitating clouds. Nevertheless, we find some vertically-uniform clouds appear at high altitudes in the tomographic retrieval where the radar image shows clear sky. This is likely due to the lack of overlapping between successive PSR scans at high altitudes, which, in turn, is determined by the aircraft moving speed and the radiometer scanning speed. We further examine the impacts of these and also many other factors to the tomographic retrieval using a group of observation system simulation experiments. We find that many conditions of the Wakasa Bay experiment were not ideal for the tomographic retrieval since it was initially designed to validate AMSR-E shallow rainfall and snowfall retrieval capabilities. For example, the aircraft flew at 144 m/s resulting in insufficient overlap between successive scan cycles, and the wind speed was about 20 m/s causing more than 2 K uncertainty in the background (sea surface) brightness temperature. This research thus provides guidelines by which to improve future field-based studies of cloud tomography.
